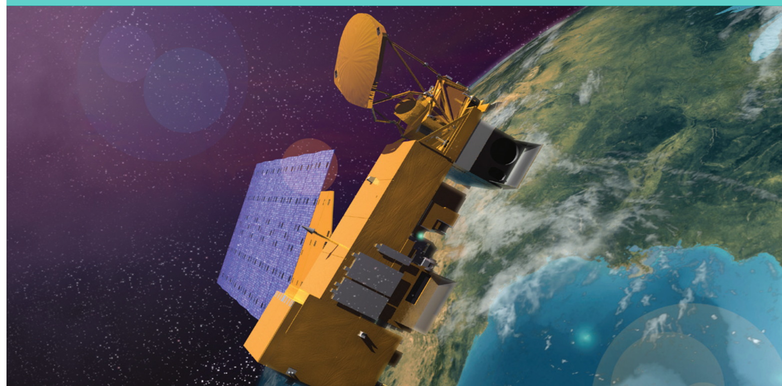
AIRS INFORMATION



AIRS Instrument Suite

Launch date	May 4, 2002
Orbit	705 km polar, Sun synchronous, 98.2 ± 0.1 degree inclination, ascending node: 1:30 pm, period: 98.88 minutes
Swath width	1650 km (± 49.5 degrees)
Ground coverage	> 95% global daily
Temporal coverage	Global, twice daily swath (day and night)
Design life	AIRS: 5 years; AMSU/HSB: 3 years

Performance Characteristics

AIRS Infrared Radiances

Spatial:	
Resolution	13.5 km at nadir; 41 km x 21.4 km at the scan extremes
Sampling	90 1.1° footprints per scan (2.67 seconds)
Spectral:	
Range	2378 channels from 3.75–15.4 μm (2665–650 cm^{-1})
Resolution	$\lambda/\Delta\lambda \approx 1200$ nominal
Sampling	$\lambda/\Delta\lambda \approx 2400$
Accuracy	± 1 ppm
Radiometric:	
Accuracy	< 0.2 K 3 sigma at 265 K
Stability	10 mK/year
Sensitivity (NEdT @ 250 K)	0.07–0.40 K from 3.75–11 μm; 0.27–0.68 K from 11.75–15.4 μm
Data Volume	56 MB per granule, 13.4 GB/day

AIRS Visible/Near-Infrared Radiances

Spatial resolution	2.3 x 1.8 km (across-track, along-track)
Spatial sampling	8 x 9 pixels per AIRS 13.5 km footprint
Spectral range	4 channels from 0.4–1.0 μm Channel 1: 0.40–0.44 μm Channel 2: 0.58–0.68 μm Channel 3: 0.71–0.92 μm Channel 4: 0.49–0.94 μm
Signal-to-noise ratio at albedo of 0.4	> 100
Radiometric accuracy	10%
Data volume	11 MB per granule, 2.6 GB/day

AMSU-A Radiances

Spatial resolution	40.5 km at nadir
Spatial sampling	30 footprints per scan (8 seconds)
Spectral range	15 channels from 23.8–89 GHz
Bandwidth	Channels 1–9: 160–400 MHz Channels 10–14: 12–150 MHz Channel 15: 2000 MHz
Sensitivity (NEdT)	0.1–1 K (9/15 channels < 0.25 K)
Data volume	0.6 MB per granule, 144 MB/day

HSB Radiances (data set available from May 5, 2002 through December 5, 2003)

Spatial resolution	13.5 km at nadir
Spatial sampling	90 1.1° footprints per scan (2.67 seconds)
Spectral range	4 channels from 150–183.3 GHz
Bandwidth	0.5–2.0 GHz
Sensitivity (NEdT)	0.28–0.58 K
Data volume	1.7 MB per granule, 408 MB/day

AIRS data products are free and are available to the science community and general public.

The Atmospheric Infrared Sounder, AIRS, was launched aboard the Aqua spacecraft in 2002 as part of NASA's Earth Observing System Afternoon Constellation of satellites known as the "A-Train." AIRS hyperspectral observations are used to produce global maps of temperature and water vapor profiles, and numerous trace gases including carbon dioxide, ozone, carbon monoxide, and methane. AIRS data improve weather prediction, validate climate models, and improve our understanding of the processes affecting weather and climate and the global transport of greenhouse gases worldwide.

HOW TO GET AIRS DATA

The Goddard Earth Sciences Data and Information Services Center (GES-DISC) at Goddard Space Flight Center serves as the central facility for the processing, archiving, and distribution of EOS Aqua data. Access to AIRS near-real-time-data, the AIRS data FTP server, the Giovanni browse tool, and other data access methods can be found here:
http://disc.sci.gsfc.nasa.gov/AIRS/data-holdings

RESOURCES

The **AIRS data support page at the GES-DISC** includes documentation, data product description, and software tools:
http://disc.sci.gsfc.nasa.gov/AIRS/

The **AIRS public website** contains information, images, and contact information:
http://airs.jpl.nasa.gov

ASK AIRS is an online form for questions about AIRS data and products:
http://airs.jpl.nasa.gov/AskAirs/

CONTACT INFORMATION

For further inquiries about AIRS data and products, please contact:

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The Jet Propulsion Laboratory, California Institute of Technology, manages the AIRS instrument suite for the National Aeronautics and Space Administration.

National Aeronautics and Space Administration

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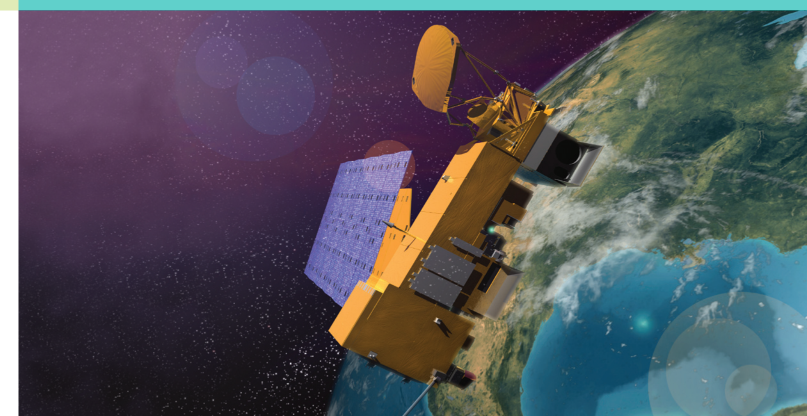
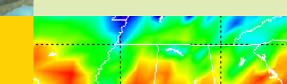
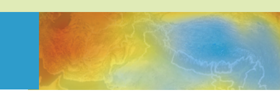
AIRS THE ATMOSPHERIC INFRARED SOUNDER ON NASA'S AQUA SATELLITE

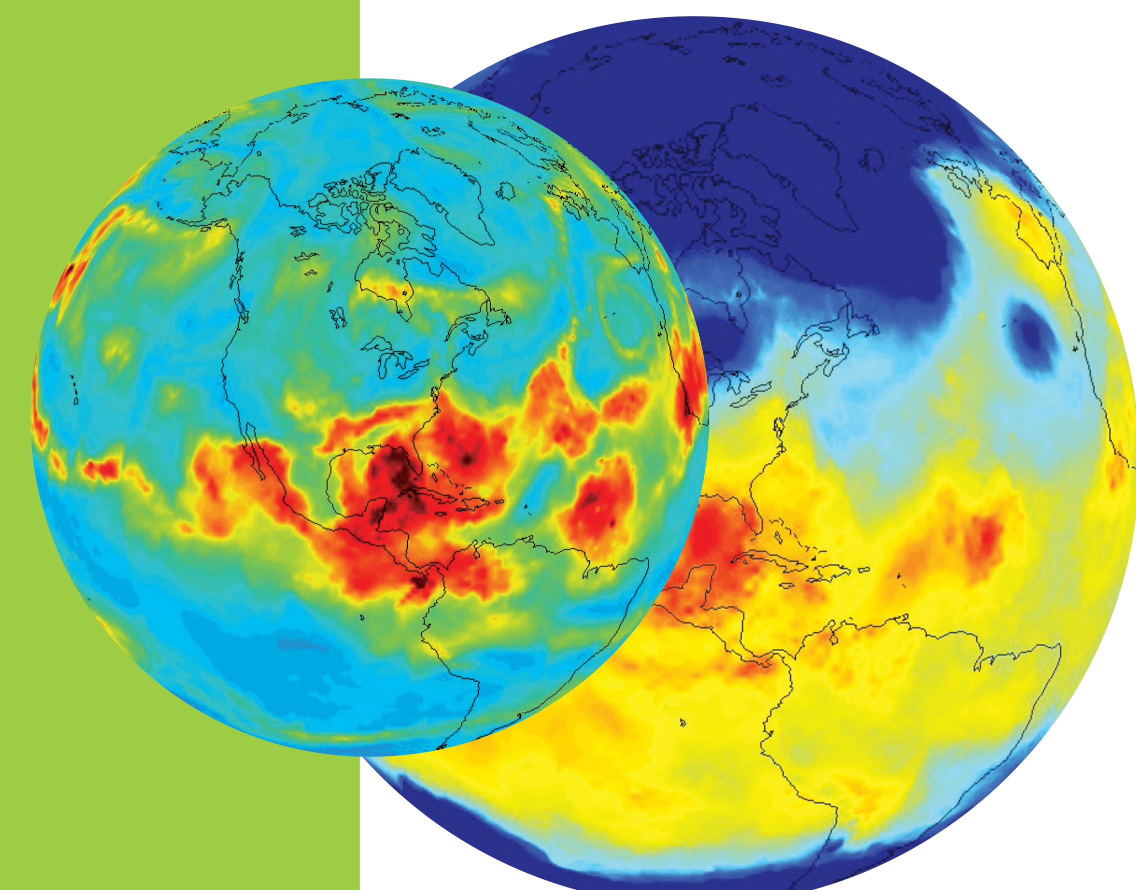


New insights into weather and climate





Daily global coverage of eleven atmospheric products for the weather, climate, and composition researcher



Globes of water vapor (left) and temperature made with data retrieved during Hurricane Katrina, 2005

AIRS GEOPHYSICAL PRODUCTS

All products are co-registered and available daily with global coverage.
The AIRS data set begins in September 2002.

WATER VAPOR

A primary standard product. The water vapor profile is the retrieved mean mass mixing ratio between standard pressure levels. Also reported is the total column moisture burden from the top-of-atmosphere to the surface.

TEMPERATURE

A primary standard product. Temperature, pressure, and geopotential height are reported at the surface, at the tropopause, and through the column on standard pressures.

OZONE

AIRS monitors the total column and 3D distribution of ozone, allowing observation of ozone transport from the stratosphere to the troposphere. AIRS ozone data are ideal for studies of stratospheric–tropospheric exchange during severe convection events and the global transport of ozone through the Brewer-Dobson circulation.

CLOUDS

Three products are produced operationally: Fractional Cloud Cover, Cloud Top Pressure, and Cloud Top Temperature. AIRS data are used by the research community to determine the phase of clouds (liquid, ice, or both), cloud particle sizes and shapes, and properties essential to the study of the relevance of clouds to Earth's climate.

SURFACE PROPERTIES

Sea Surface Temperature, Land Surface Temperature, and Surface Emissivity are reported. The emissivity over land is a highly desirable quantity for weather forecast data assimilation.

CARBON MONOXIDE

The best sensitivity is in the mid- to lower troposphere. Also reported are CO effective pressure, effective CO volume mixing ratio profile, and total column CO. AIRS/AMSU data have provided the most detailed, daily global observation of transport of mid-tropospheric CO from biomass burning emissions to date.

CARBON DIOXIDE

AIRS reports the daytime and nighttime global distribution of carbon dioxide in the mid-troposphere at a nadir resolution of 90 km x 90 km. The high spectral resolution and stability of AIRS allow a measurement accuracy between 1.5 ppm and 2 ppm, making it ideal for mapping the distribution and transport of carbon dioxide levels in the free troposphere.

DUST

AIRS is very sensitive to atmospheric aerosols. Dust is expressed as a flag indicating an identifiable amount of material present in the atmosphere. AIRS can retrieve dust heights, and possibly infer dust composition and effective particle size.

RESEARCH PRODUCTS

METHANE

Reported are the retrieved volume mixing ratio, methane effective pressure, and retrieved total column methane. Sensitivity is mainly in the mid-troposphere.

OUTGOING LONG-WAVE RADIATION

Calculated from the AIRS retrieved profiles and radiance spectrum. Useful for understanding radiative properties associated with AIRS cloud, water, and composition products, and for comparison with CERES to ensure AIRS retrievals are radiatively consistent for tests of climate models.

SULFUR DIOXIDE

AIRS sensitivity to sulfur dioxide is primarily visible in volcanic activity, and the measurement is expressed in terms of a temperature difference. The AIRS SO_2 measurement is used by the Volcanic Ash Advisory Center.


Isosurfaces of global water vapor

AIRS PRODUCTS

Radiance Product	Data Product	Resolution (km)	Accuracy
AIRS IR Radiance	AIRS Level 1B	15	< 0.2 K 3 sigma at 265 K
AIRS Vis/NIR Radiance	Vis/NIR Level 1B	2.3	15–20%
AMSU Radiance	AMSU Level 1B	45	1–3 K
HSB Radiance	HSB Level 1B	15	1–3 K
Geophysical Product	**Data Product**	**Level 2 Data Product Resolution (km)**	**Precision**
Cloud Cleared IR Radiance	Level 2	45	1.0 K
Water Vapor Profile	Level 2, 3*	45	15% / 2 km
Total Precipitable Water	Level 2, 3*	45	5%
Temperature	Level 2, 3*	45	1 K / km
Total Ozone Column	Level 2, 3*	45	5%
Ozone Profile	Level 2, 3*	45	20%
Cloud Top Pressure	Level 2, 3*	45	1–2 km ***
Effective Cloud Temperature	Level 2, 3*	45	2.0 K
Fractional Cloud Cover	Level 2, 3*	15	20%
Sea Surface Temperature	Level 2, 3*	45	1.0 K
Land Surface Temperature	Level 2, 3*	45	2-3 K
Land Surface Emissivity	Level 2, 3*	45	10%
Carbon Monoxide	Level 2, 3*	45	15%
Carbon Dioxide	Level 2, 3*	45	1–2 ppm
IR Dust	Level 1B (flag)** Level 2	45	0.5 K
Research Product	**Data Product**	**Level 2 Data Product Resolution (km)**	**Precision**
Methane	Level 2, 3*	45	2%
Outgoing Longwave Radiation	Level 2 Support	45	5 W / m² ****
Sulfur Dioxide	L1B (flag), Level 2	45	1 DU

*AIRS L3 data are produced in 1 x 1 degree bins at daily, 8-day, and monthly averages.

** AIRS IR Dust L1B resolution is 15 km.

*** Precision is reported in height space.

**** Based on monthly mean Level 3.

KEY FINDINGS AND PUBLICATIONS

The findings and publications listed here are not complete. Please visit http://airs.jpl.nasa.gov/. Significant Findings and AIRS Publications Database are listed in the Science section.

CLIMATE

FINDING

AIRS data show that surface warming leads to an increase in water vapor. This water vapor acts as a greenhouse gas and amplifies the surface warming. The AIRS observations are also consistent with warming predicted by numerical climate models, increasing confidence in model predictions of future warming.

Dessler, A. E., Z. Zhang, P. Yang (2008), **Water-Vapor Climate Feedback Inferred from Climate Fluctuations, 2003–2008**, *Geophys. Res. Lett., 35, L20704, doi:10.1029/2008GL035333.*

Gettelman, A., and Q. Fu (2008), **Observed and Simulated Upper-Tropospheric Water Vapor Feedback**, *J. Climate, 21, 3282–3289.*

FINDING

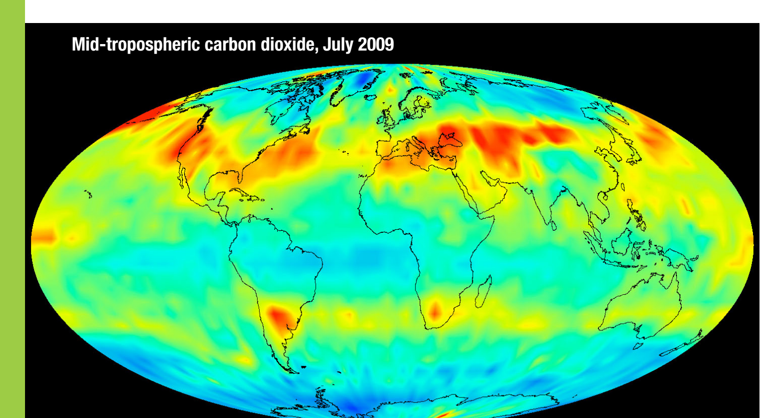
AIRS moisture fields differ from 6 major climate models such that the models are too dry below 800 mb in the tropics compared with AIRS, and too moist between 300 mb and 600 mb especially in the extra-tropics. This affects model predictions of future climate warming.

Pierce, D. W., T. P. Barnett, E. J. Fetzer, P. J. Gleckler (2006), **Three-Dimensional Tropospheric Water Vapor in Coupled Climate Models Compared with Observations from the AIRS Satellite System**, *Geophys. Res. Lett., 33, L21701, doi:10.1029/2006GL027060.*

FINDING

Power law scaling exponents from temperature and water vapor derived from AIRS show consistency with previous modeling, observational, and theoretical studies. However, the results show much more structure and variability over the globe and will provide crucial information for constraining subgrid-scale cloud parameterizations.

Kahn, B. H., and J. Teixeira (2009), **A Global Climatology of Temperature and Water Vapor Variance Scaling from the Atmospheric Infrared Sounder**, *J. Climate, 22, 5558–5576, doi:10.1175/2009JCLI2934.1.*

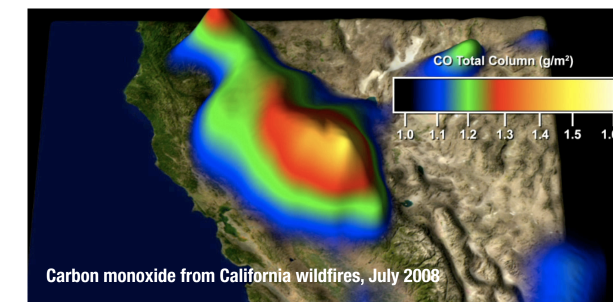

Mid-tropospheric carbon dioxide, July 2009

WEATHER

FINDING

Assimilating even small amounts of AIRS data improves forecast significantly: Less than 1% of AIRS spectra extends the NCEP global 6-day forecast by 6 hours in both hemispheres. AIRS data are now used routinely by major weather forecast centers around the world, including NCEP (US) and ECMWF (Europe).

Le Marshall, J., J. Jung, M. Goldberg, C. Barnet, W. Wolf, J. Derber, R. Treadon, S. Lord (2008), **Using Cloudy AIRS Fields of View in Numerical Weather Prediction**, *Australian Meteorological Magazine, 57, 3, 249–254.*



Carbon monoxide from California wildfires, July 2008

COMPOSITION

AIRS offers a unique view of trace gases with good sensitivity in the mid- to upper troposphere. These data are useful for understanding global circulation patterns of these important gases. AIRS data are complementary to measurements made by other satellites by placing their observations in "context" with global transport conditions. Please refer to the following publications for more information:

Carbon Dioxide: Chahine, M.T. et al. (2008), **Satellite Remote Sounding of Mid-Tropospheric CO_2**, *Geophys. Res. Lett., 35, September, doi:10.1029/2008GL035022, in press.*

Ozone: Pittman, J. V., L. L. Pan, J. C. Wei, F. W. Irion, X. Liu, E. S. Maddy, C. D. Barnet, K. Chance, R. Gao (2009), **Evaluation of AIRS, IASI, and OMI Ozone Profile Retrievals in the Extratropical Tropopause Region Using in situ Aircraft Measurements**, *J. Geophys. Res., doi:10.1029/2009JD012493, in press.*

Carbon Monoxide: McMillan, W. W., R. Pierce, L. C. Sparling, G. Osterman, K. McCann, M. L. Fischer, B. Rappenglck, R. Newsom, D. Turner, C. Kittaka, K. Evans, S. Biraud, B. Lefer, A. Andrews, S. Oltmans, **An Observational and Modeling Strategy to Investigate the Impact of Remote Sources on Local Air Quality: A Houston, Texas Case Study from TEXAQS II**, *J. Geophys. Res., in press, doi:10.1029/2009JD011973.*

Methane: Xiong, X., S. Houweling, J. Wei, E. Maddy, F. Sun, C. Barnet (2009), **Methane Plume over South Asia during the Monsoon Season: Satellite Observation and Model Simulation**, *Atmos. Chem. Phys., 9, 783–794.*